Alaska Fisheries Data Series Number 2002-3
May 2002

Estimation of sockeye and coho salmon escapement in Mortensens Creek, Izembek National Wildlife Refuge, 2001

Kellie S. Whitton

U.S. Fish and Wildlife Service
King Salmon Fishery Resource Office
P.O. Box 277
King Salmon, AK 99613
(907) 246-3442

TABLE OF CONTENTS

LIST OF FIGURES

Figure

LIST OF TABLES

Table

LIST OF APPENDICES

Appendix

Alaska Fisheries Data Series Number 2002-3

Estimation of sockeye and coho salmon escapement in Mortensens Creek, Izembek National Wildlife Refuge, 2001

Kellie S. Whitton

U.S. Fish and Wildlife Service
King Salmon Fishery Resources Office
P.O. Box 281
King Salmon, AK 99613

Abstract.& A fixed picket weir was operated on Mortensens Creek from 1 July to 26 October 2001. Coho salmon *Onchorynchus kisutch* was the most abundant species counted through the weir (N=5,279) followed by sockeye *O. nerka* (N=4,268), chum *O. keta* (N=21), and pink salmon *O. gorbushca* (N=15). Dolly Varden char *Savelinus malma* were also observed at the weir. Sockeye salmon sampled at the weir were 42% female (SE=2.5%), and represented nine age groups. Age 1.3 was estimated to be 67% (SE=2.7%) of the escapement followed by age 1.2 (16%; SE=2.0%). The mid-eye-to-fork length for male sockeye salmon ranged from 479 to 632 mm and from 467 to 612 mm for females. Coho salmon sampled at the weir were 40% female (SE=2.7%) and represented three age groups. Age 2.1 was estimated to account for 82% (SE=2.2%) of the escapement followed by age 1.1 (14%; SE=1.9%) and 3.1(4%; SE=1.2%). The mid-eye-to-fork length for male coho salmon ranged from 340 to 735 mm and from 490 to 704 mm for females.

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) expressed concern that the lack of an in-season estimate of sockeye *Oncorhynchus nerka* and coho *O. kisutch* salmon escapement into Mortensens Creek may jeopardize the health of the runs, as well as opportunities for subsistence and sport fishing (Arnold Shaul, ADF&G, personal communication). The outlet of Mortensens Creek is one of the few areas where sockeye salmon are available for harvest by subsistence users from King Cove and Cold Bay. In 1999, escapement of sockeye salmon in Mortensens Creek was estimated to be 3,600 fish with an additional 1,378 sockeye salmon harvested in the subsistence and commercial fisheries (ADFG 2000). It appeared that the subsistence and commercial harvest in 1999 may have been more than 25% of the entire run. In addition, about 30% of the subsistence harvest of sockeye salmon was taken by Alaska residents living outside of Cold Bay and King Cove. In 1999, 279 coho salmon were harvested in the commercial and subsistence fisheries (ADFG 2000).

King Cove residents were also concerned about sport fishing effects on coho salmon in Mortensens Creek. No creel survey or harvest information is available for Mortensens Creek. The State of Alaska annual mail out sportfish survey does not specifically estimate sport harvest for Mortensens Creek. However, the report does estimate sport harvest for the Cold Bay area which would primarily include Russell and Mortensens Creeks. The average sport harvest for this area from 1996 to 1998 was 671 coho salmon (Howe et al. 1997, Howe et. al. 1998, and Howe et al. 1999).

An escapement goal of 3,200 to 6,400 (Nelson and Lloyd 2001) has been established for sockeye salmon, but currently there is no goal for coho salmon. Current management of these species is based on aerial surveys that are used to assess escapement during and after the runs enter the stream. The accuracy of the aerial surveys is questionable due to dark stream bottoms, turbid water, and inclement weather. An accurate in-season estimate of escapement will help managers to ensure that a sufficient number of each species is available for subsistence harvest. Escapement estimates will also provide managers with the data needed to address concerns about overharvest and will be the first step in resolving the conflict between subsistence and sport users.

OBJECTIVES

1. Enumerate daily passage of sockeye and coho salmon through a weir on Mortensens Creek.
2. Describe the run-timing of sockeye and coho salmon through the weir.
3. Estimate the sex and age compositions of sockeye and coho salmon such that simultaneous 90% confidence intervals have a maximum width of 0.20.
4. Estimate the mean length of sockeye and coho salmon by sex and age.
5. From objective one, determine if the abundance of sockeye and coho salmon returns in Mortensens Creek are adequate to allow subsistence fishing
6. From objective one, determine if the abundance of sockeye and coho salmon returns in Mortensens Creek are adequate to allow sport fishing.

METHODS

Study Area

Mortensens Creek originates in the foothills of Frosty Peak and flows north towards the town of Cold Bay, Alaska before eventually turning south and emptying into Mortensens Lagoon (Figure 1). Little hydrological information is available, but the drainage consists of several small tributaries, ponds, and a lake. Mortensens Creek supports populations of sockeye, coho, chum (*O. keta*), and pink (*O. gorbuscha*) salmon and Dolly Varden char (*Salvelinus malma*).

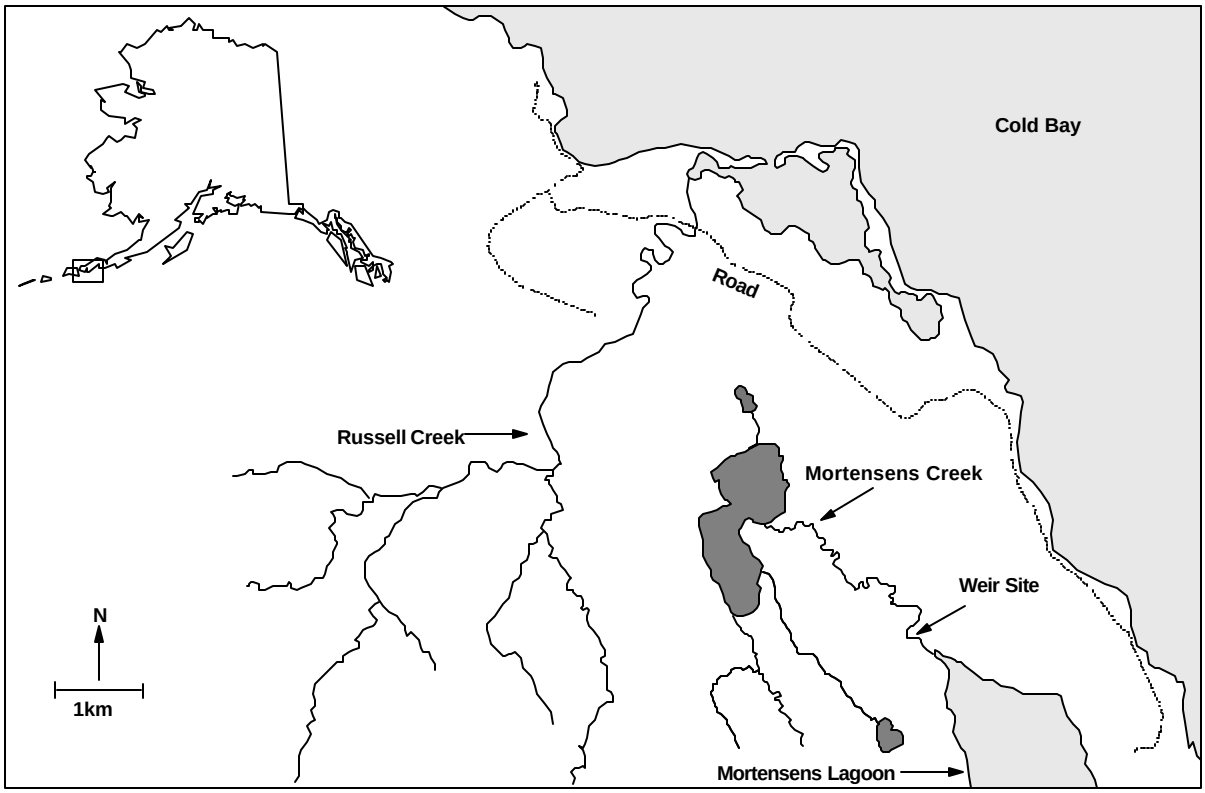


Figure 1. Map of Mortensens Creek and the weir site.

Weir Operation

The King Salmon Fishery Resources Office installed and operated a weir on Mortensens Creek, 1 July to 26 October 2001. The weir was constructed of 12 mm diameter electrical metal tubing pickets separated by 38 mm lengths of polyvinyl chloride pipe. A 4 mm diameter hole was drilled about 30 cm from both ends of each picket. Four-mm diameter aircraft cable was used to string the pickets and spacers together, and clamps were attached to the ends of the cables to create 3-m long weir panels of varying heights to accommodate differences in channel depth.

Weir panels were supported by fence posts and an 8 mm diameter galvanized aircraft cable stretched across the stream. The supporting cable was anchored to the stream banks using "dead men" buried vertically at a depth that allowed the cable to be suspended just above the water surface. Each "dead man" was buried far enough from the stream channel to reduce the chance it would fail during high water. Weir panels were hooked together and placed across the channel at an angle to direct upstream migrant fish to the trap box. The continuous panel was tilted downstream in relation to the stream bed to shunt debris to the water surface, thereby maintaining free-flow of water through the pickets. A 4.6 m wide strip of Amoco® geotextile cloth was anchored beneath the weir to prevent substrate erosion beneath the panels. The tops of the panels

were wired to the supporting cable. The stream banks at each end of the weir were armored with geotextile cloth to prevent erosion.

A fyke was installed in the weir, leading to an upstream migrant holding pen. The fyke was located as close to the stream bank as adequate depth would allow. The depth in the holding pen was greater than 0.5 m to help minimize fish escaping from the pens. The entire weir was inspected, cleaned, and maintained daily to insure integrity.

A dip net was used to remove fish from the holding pen for biological sampling at least once a day or more often as the number moving through the weir increased. Weekly samples of sockeye and coho salmon were examined for gill net marks, measured, sexed, and scales were extracted for age analysis. Coho and sockeye salmon in excess of sampling needs were counted and identified as they were passed through an opening in the weir or trapbox. Fish were not allowed to hold downstream of the weir. If this occurred, the trap box was closed and the counting panel was opened to facilitate upstream passage. A Hobo® thermograph (model number H08-001-02) was installed at the weir to monitor water temperatures. Water temperature was recorded every two hours and summarized as daily maximum, minimum, and mean (Appendix 1).

Escapement, Age, Sex, and Length Data

Data on sockeye and coho salmon age, sex, and length (ASL) were collected using a temporally stratified sampling design (Cochran 1977), with statistical weeks defining strata. Sockeye and coho salmon were sampled most weeks for ASL information, and to the extent logistically feasible, the sample was collected uniformly throughout each week (Sunday through Saturday). Coho and sockeye salmon were sampled primarily during high tides. During other times of the day, water depth often prevented upstream migration. To avoid potential bias caused by the selection or capture of individual fish, all sockeye and coho salmon within the trap were included in the sample even if the target number of fish was exceeded.

During each week, a sample of sockeye and coho salmon was trapped, examined for gill net marks, length measured from mid-eye-to-fork of the tail (MEF), sex determined, and scales collected for aging. Mid-eye-to-fork lengths were measured to the nearest millimeter. One scale from sockeye salmon and three scales from coho salmon were removed from the preferred area on the left side of adult salmon (Jearld 1983). Scales samples were cleaned and mounted on gummed scale cards. The Alaska Department of Fish and Game-Kodiak pressed and aged the scales. Salmon ages are reported according to the European method (Koo 1962).

Table 1. Estimated maximum weekly sample size goals.

Species	Number of Age Categories	Sample Size	Estimated frequency of Unreadable Scales (%)	Adjusted Sample Size
Sockeye Salmon	4	121	10	135
Coho Salmon	3	109	10	122

Maximum weekly sample size goals were established so that simultaneous 90% interval estimates of age composition for each week have maximum widths of 0.20 (Bromaghin 1993) (Table 1). Sample sizes obtained using these methods were increased to account for the expected number of unreadable scales. However, the derivation of maximum sample size goals was based on a multinomial sampling model (sampling with replacement or small samples relative to a large population). Seasonal escapement at Mortensens Creek was estimated to be < 5,000 for coho salmon and < 10,000 for sockeye salmon during most years. The weekly sample size goal was expected to be a substantial fraction of the passage in some weeks; therefore, a target of about 20% of the weekly escapement was sampled during weeks of low passage when the maximum sample size goal could not be practically obtained. This was sufficient to describe the age composition and reduced the number of fish handled at the weir. For sample size determination, age categories were defined as the total age (fresh water and ocean age combined) for both sockeye (ages 3, 4, 5, and 6) and coho salmon (ages 3, 4, and 5)(Table 1).

Characteristics of fish passing through the weir were estimated using standard stratified random sampling estimators (Cochran 1977). Within a given stratum m, the proportion of species *i* passing the weir that were of sex *j* and age *k* (p_{ijkm}) was estimated as

$$\hat{p}_{ijkm} = \frac{n_{ijkm}}{n_{i++m}}, \tag{1.1}$$

where n_{ijkm} denotes the number of fish of species i, sex j, and age k sampled during stratum m and a subscript of "+" represents summation over all possible values of the corresponding variable, e.g., n_{i++m} denotes the total number of fish of species i sampled in stratum m. The variance of $\hat{p}_{ijkm}$ was estimated as

$$\hat{v}\left(\hat{p}_{ijkm}\right) = \left(1 - \frac{n_{i++m}}{N_{i++m}}\right)\frac{\hat{p}_{ijkm}\left(1 - \hat{p}_{ijkm}\right)}{n_{i++m} - 1} \tag{1.2}$$

where N_{i++m} denotes the total number of species i fish passing the weir in stratum m. The estimated number of fish of species i, sex j, and age k passing the weir in stratum m (N_{ijkm}) was

$$\hat{N}_{ijkm} = N_{i+m}\hat{P}_{ijkm} \tag{2.1}$$

with estimated variance

$$\hat{v}(\hat{N}_{ijkm}) = N^{2}_{i++m}\hat{v}(\hat{p}_{ijkm}) \tag{2.2}$$

Estimates of proportions for the entire period of weir operation were computed as weighted sums of the stratum estimates, i.e.,

$$\hat{p}_{ijk} = \sum_{m}\left\{\frac{N_{i++m}}{N_{i+++}}\right\}\hat{p}_{ijkm} \tag{3.1}$$

and

$$\hat{v}\left(\hat{p}_{ijk}\right) = \sum_{m}\left(\frac{N_{i++m}}{N_{i+++}}\right)^{2}\hat{v}\left(\hat{p}_{ijkm}\right) \tag{3.2}$$

The total number of fish in a species and age category passing the weir during the entire period of operation was estimated as

$$\hat{N}_{ij} = \sum_{m}\hat{N}_{ijm} \tag{4.1}$$

with estimated variance

$$\hat{v}\left(\hat{N}_{ij}\right) = \sum_{m}\hat{v}\left(\hat{N}_{ijm}\right). \tag{4.2}$$

If the length of fish of species i, sex j, and age k sampled in stratum m is denoted x_{ijkm}, the sample mean length of fish of species i, sex j, and age k within stratum m was computed as,

$$\bar{x}_{ijkm} = \frac{\sum x_{ijkm}}{n_{ijkm}} \tag{5.1}$$

With corresponding sample variance s^2_{ijkm}

$$s^2_{ijkm} = \left(1 - \frac{n_{ijkm}}{\hat{N}_{ijkm}}\right) \frac{\sum \left(x_{ijkm} - \bar{x}_{ijkm}\right)^2}{n_{ijkm} - 1}. \tag{5.2}$$

The mean length of all fish of species i, sex j, and age k $\left(\hat{\bar{x}}_{ijk}\right)$ was estimated as a weighted sum of the stratum means, i.e.,

$$\hat{\bar{x}}_{ijk} = \sum_m \left(\frac{\hat{N}_{ijkm}}{\hat{N}_{ijk}}\right) \bar{x}_{ijkm}. \tag{6.1}$$

An approximate estimator of the variance of $\hat{\bar{x}}_{ijk}$ was obtained using the delta method (Seber 1982),

$$\hat{v}\left(\hat{\bar{x}}_{ijk}\right) = \sum_m \left\{ \hat{v}\left(\hat{N}_{ijkm}\right) \left[\frac{\bar{x}_{ijkm}}{\sum_x \hat{N}_{ijkx}} - \sum_y \frac{\hat{N}_{ijky}}{\left(\sum_x \hat{N}_{ijkx}\right)^2} \bar{x}_{ijky} \right]^2 + \left(\frac{\hat{N}_{ijkm}}{\sum_x \hat{N}_{ijkx}} \right)^2 s^2_{ijkm} \right\} \tag{6.2}$$

During sampling, biological data were collected on a weekly basis. However, for the purposes of data analysis, strata were redefined to account for escapement during weeks when no fish were sampled. Sockeye salmon escapement was divided in to six strata, and coho salmon escapement into five (Table 2).

Table 2. Strata (time periods) used for analysis of Mortensens Creek coho and sockeye salmon biological data.

Stratum	Coho Salmon	Sockeye Salmon
1	21 August - 7 September	1 July - 12 July
2	8 September - 17 September	13 July - 20 July
3	18 September - 29 September	21 July - 27 July
4	30 September - 13 October	28 July - 5 August
5	14 October - 26 October	6 August - 11 August
6	-------	12 August - 23 September

RESULTS

Weir Operation

Operation of the weir began 1 July and continued through 26 October 2001. Occasionally high tides associated with strong southeast winds resulted in high water exceeding the height of the weir (2 and 14 July, 11 and 19 September, and 7 and 16 October). On those days it is likely that some fish may have passed upstream of the weir without being counted. On 24 July the weir was down for about 30 minutes for modifications, and during that time no fish were observed passing the weir. On 19 September a high tide and strong winds pushed the weir over and an unknown number of fish may have passed upstream of the weir. Visibility in Mortensens Creek was poor due to high turbidity, therefore, fish passing through the weir may have been under counted at times.

Escapement, Sex, Length, and Age Data

Coho salmon was the most abundant species counted through the weir (N=5,279) followed by sockeye (N=4,268), chum (N=21), and pink salmon (N=15) (Appendix 2). Picket spacing (38 mm) allowed small pink salmon to pass through the weir without being counted and therefore, the number passed at the weir likely underestimates the actual escapement. Dolly Varden char were also observed at the weir.

Sockeye Salmon

The cumulative escapement of sockeye salmon in Mortensens Creek in 2001 was estimated to be 4,268. Sockeye salmon were first captured at the weir on 1 July 2001, and the peak escapement

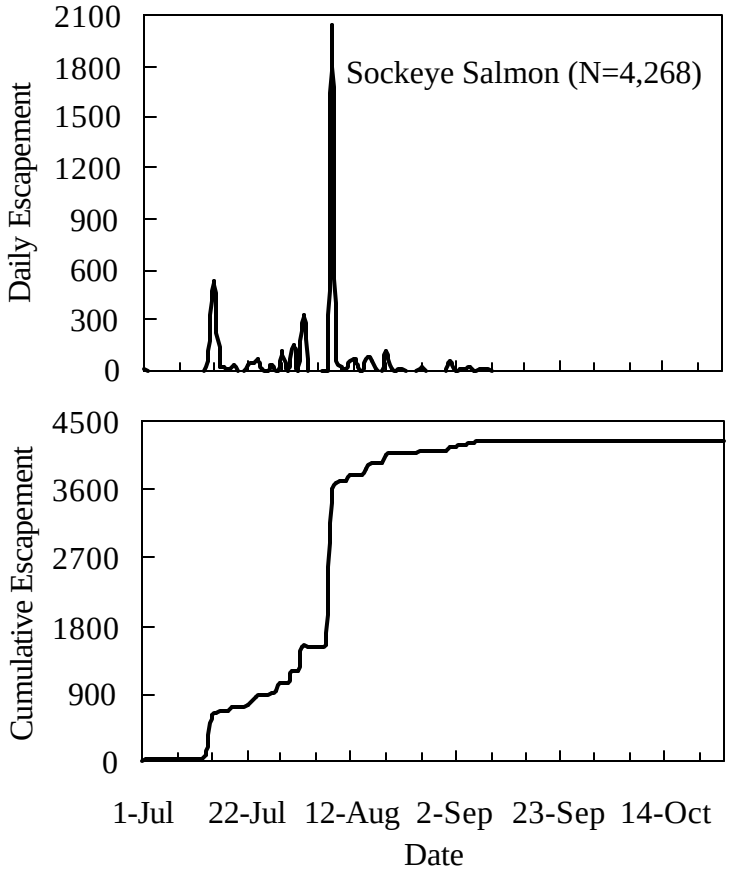


Figure 2. Daily (upper) and cumulative escapement (lower) of sockeye salmon in Mortensens Creek, 2001.

occurred on 8 August (2,057 fish or 48% of the total run) (Figure 2; Appendix 2). Sixty-eight percent of the escapement estimate occurred on three days (2,923 fish). No sockeye salmon were captured at the weir after 10 September. The estimated sex composition for the run varied from 12% (SE=3.4%) female early in the run to 50% (SE=4.3%) in late July (Table 3). The sex composition averaged for the entire season was 42% female (SE=2.5%). Sockeye salmon that were not identified as male or female were not included in the analysis of sex composition (N=4). Sockeye salmon sampled in Mortensens Creek were categorized into nine age groups, but four age classes (1.4, 2.1, 2.4, and 2.3) were <2% of the fish sampled (N=405; Table 4). Age 1.3 was estimated to be 67% (SE=2.7%) of the escapement followed by age 1.2 (16%; SE=2.0%). Sockeye salmon that could not be aged, were not included in the analysis for age composition (N=110). The mid-eye-to-fork length (MEF) for male sockeye salmon ranged from 479 to 632 mm and from 467 to 612 mm for females (Figure 3 and Table 5). The average MEF for male sockeye salmon was larger than females for all age classes identified in sampled fish.

Table 3. Estimated sex composition and standard errors (SE) of sockeye salmon sampled by stratum in Mortensens Creek, 2001

				Escapement						
	Sample			Percent			Number			
Stratum	N	Male	Female	Male	Female	SE	Male	Female	SE	Total
Jul 1 - Jul 12	16	14	2	88	12	3.4	17	2	0.6	19
Jul 13 - Jul 20	115	78	37	68	32	0.2	227	478	28.2	705
Jul 21 - Jul 27	82	41	41	50	50	4.3	104	104	9.0	208
Jul 28 - Aug 5	45	28	17	62	38	7.0	370	225	41.8	595
Aug 6 - Aug 11	142	78	64	55	45	4.1	1,199	984	88.4	2,183
Aug 12 - Sep 10	111	61	50	55	45	4.2	307	251	23.7	558
Total	511	300	211	58	42	2.5	2,506	1,762	104.9	4,268

Coho Salmon

An estimated 5,279 coho salmon passed the weir on Mortensens Creek in 2001. Coho salmon were first captured at the weir on 21 August (N=1), and the peak daily escapement occurred on 11 September (1,535 fish) (Figure 4; Appendix 2). Coho salmon were not observed at the weir after 20 October 2001. The sex composition of the run varied from 27% (SE=12.8%) female during the first stratum (21 August - 7 September) to 52% (SE=4.9%) during stratum three (18 to 29 September; Table 6). The sex composition for the entire season averaged 40% female (SE=2.7%). Coho salmon that were not identified as male or female were not included in the analysis of sex composition (N=25). Three age classes were identified from 316 of the 356 coho salmon sampled at the weir (Table 7). Age 2.1 was estimated to account for 82% (SE=2.2%) of the sample followed by age 1.1 (14%; SE=1.9%) and 3.1(4%; SE=1.2%). Fish that could not be aged, were not included in the analysis of age composition (N=40). The MEF for male coho salmon ranged from 340 to 735 mm and from 490 to 704 mm for females (Figure 5 and Table 8). The average length of male coho salmon was larger than for females for all age classes, and average length increased with age for both males and females.

DISCUSSION

Sockeye salmon were captured at the weir the day it was installed (N=11), indicating that we may have missed the early portion of the run. However, after passing 17 sockeye salmon during the first two days of operation, only three were passed the following 11 days. Therefore, we assumed that few sockeye salmon passed upstream prior to weir installation. Occasionally high tides associated

Table 4. Estimated age composition (%), sample sizes (N), and standard errors (SE) of sockeye salmon by stratum in Mortensens Creek, 2001.

							Escapement									
	Sample						0.3		1.2		1.3		2.2		2.3	
Stratum	N	0.3	1.2	1.3	2.2	2.3	%	SE	%	SE	%	SE	%	SE	%	SE
1	5	1	0	3	0	1	20	17.2	0	0	60	21.0	0	0	20	17.2
2	92[a]	6	8	71	0	6	7	2.4	9	2.8	77	4.1	0	0	7	2.4
3	74	6	4	58	1	5	8	2.6	5	2.1	78	3.9	1	1.1	7	2.4
4	35[a]	1	5	20	5	3	3	2.8	14	6.0	57	8.2	14	5.8	9	4.7
5	114[a]	2	18	77	5	9	2	1.2	16	3.3	68	4.3	4	1.9	8	2.5
6	85	1	29	51	2	2	1	1.1	34	4.8	60	4.9	2	1.5	2	1.5
Total	405[a]	17	64	280	13	26	3	0.9	16	2.0	67	2.7	4	1.3	7	1.5

[a] Sample sizes for listed age classes do not equal the total sample size because ages 1.4, 2.1, 2.4, and 3.3 (N=5) were not included as they were <2% of the total sample.

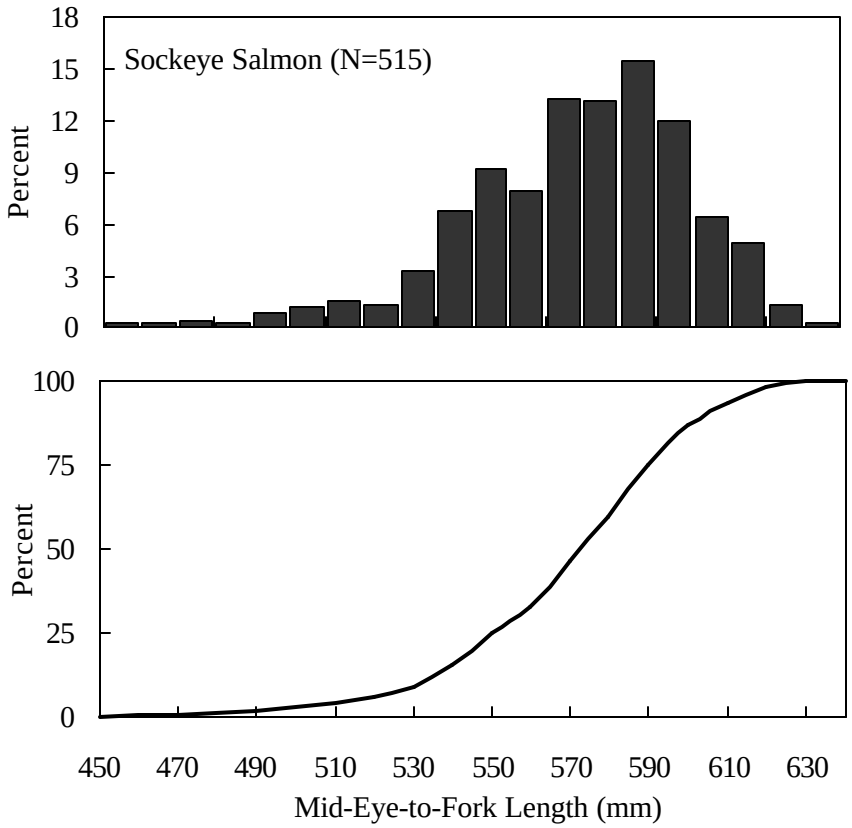


Figure 3. Length frequency (upper) and cumulative length frequency (lower) for sockeye salmon sampled at the Mortensens Creek weir, 2001.

with strong southeast winds may have allowed fish to pass upstream without being counted. It is unlikely that large numbers of sockeye salmon passed upstream undetected during these events as the two high tide-wind events that occurred in July happened early in the run, and the events in September and October occurred after the sockeye salmon run had ended. However, based on aerial surveys, the Alaska Department of Fish and Game estimated sockeye salmon escapement at 9,100, using about a two-week stream life on the spawning grounds (Joe Dinnocenzo, ADF&G, personal communication). The discrepancy between weir and aerial counts suggests that either a large number of sockeye salmon passed upstream of the weir without being counted, or aerial counts overestimate the actual escapement.

In contrast, the high tide-wind events that occurred in September and October likely allowed coho salmon to pass upstream of the weir undetected. The peak daily escapement of coho salmon (1,535 fish) occurred on 11 September during a high tide-wind event. Coho salmon were observed swimming over and around the weir during the evening high tide (2230 to 2400 hours).

Table 5. Average, standard error (SE), range, and sample size of lengths taken from sockeye salmon in Mortensens Creek, 2001.

	Ages[a]				
	0.3	1.2	1.3	2.2	2.3
Females					
Mean Length	562	524	560	503	566
SE	3.6	4.5	3.2	5.7	4.3
Range	478-534	460-572	501-612	467-533	521-594
Sample Size	7	26	125	4	9
Males					
Mean Length	589	549	590	539	589
SE	5.3	3.0	2.3	3.9	3.0
Range	556-621	489-616	516-632	479-595	539-606
Sample Size	10	38	155	9	17
All Fish					
Mean Length	580	536	577	529	578
SE	4.5	3.3	2.8	4.5	2.8
Range	534-621	460-616	501-632	467-595	521-606
Sample Size	17	64	280	13	26

[a] Ages 1.4, 2.2, 2.4, and 3.3 (N=5) were not included as they were <2% of the total sample.

In addition, large numbers of coho salmon were passed during the week when the weir went down (19 September; Appendix 1). Therefore, an unknown number of fish may have passed upstream before the weir was repaired. Due to several high tide-wind events, it is likely that the actual coho salmon escapement was higher than counts taken at the weir. No aerial surveys were conducted after 26 September, and although about 90% of the coho salmon escapement had occurred prior to that date, none were recorded in the aerial surveys.

Turbidity may have also contributed to undercounting at the weir, but modifications to the counting areas were made to reduce this problem. A white substrate was installed at the exit to the trap box to improve visibility. In addition, when fish were passed through the counting panel, a rolled up weir panel was laid on the stream bottom so that fish had to swim up and over the panel to go go upstream. Raising fish in the water column improved our ability to accurately count fish going upstream.

Picket spacing on the weir allowed small pink salmon to pass upstream without being counted, but since few were observed at the weir, it is unlikely that large numbers passed uncounted. It is possible that Mortensens Creek supports small populations of pink and chum salmon, or the fish observed at the weir were straying from nearby streams (e.g. Old Mans Lagoon and Russell Creek). A few Dolly Varden char were observed at the weir, but only presence was recorded.

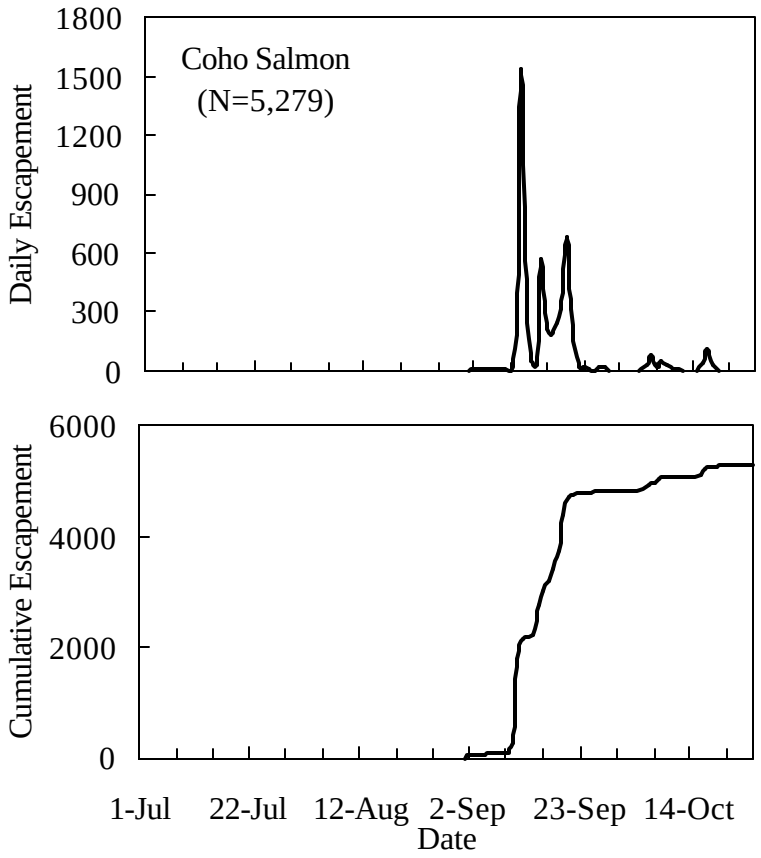


Figure 4. Daily (upper) and cumulative escapement (lower) of coho salmon in Mortensens Creek, 2001.

Table 6. Estimated sex composition and standard errors (SE) of coho salmon by stratum in Mortensens Creek, 2001.

				Escapement						
	Sample			Percent			Number			
Stratum	N	Male	Female	Male	Female	SE	Male	Female	SE	Total
Aug 21 - Sep 7	11	8	3	73	27	12.8	47	18	8.3	65
Sep 8 - Sep 17	167	110	57	66	34	3.6	2,045	1,060	111.1	3,105
Sep 18 - Sep 29	98	47	51	48	52	4.9	789	856	80.9	1,645
Sep 30 - Oct 13	36	19	17	53	47	7.8	140	125	20.8	265
Oct 14 - Oct 26	19	13	6	68	32	10.4	136	63	20.7	199
Total	331	197	134	60	40	2.7	3,142	2,137	138.1	5,279

Table 7. Estimated age composition (percent and number) and standard errors (SE) of coho salmon by stratum in Mortensens Creek, 2001.

					Escapement											
	Sample				1.1				2.1				3.1			
Stratum	N	1.1	2.1	3.1	%	SE	No.	SE	%	SE	No.	SE	%	SE	No.	SE
1	19	3	15	1	16	7.2	10	4.7	79	8.1	51	5.3	5	4.4	3	2.9
2	145	14	123	8	10	2.4	300	74.6	85	2.9	2,634	90.6	6	1.9	171	57.7
3	93	18	73	2	19	4.0	318	65.8	78	4.2	1,291	68.4	2	1.5	35	24.2
4	41	5	36	0	12	4.8	32	12.6	88	4.8	233	12.6	0	0	0	0
5	18	5	13	0	28	10.4	55	20.6	72	10.4	144	20.6	0	0	0	0
Total	316	45	260	11	14	1.9	716	102.5	82	2.2	4,353	116.2	4	1.2	210	62.6

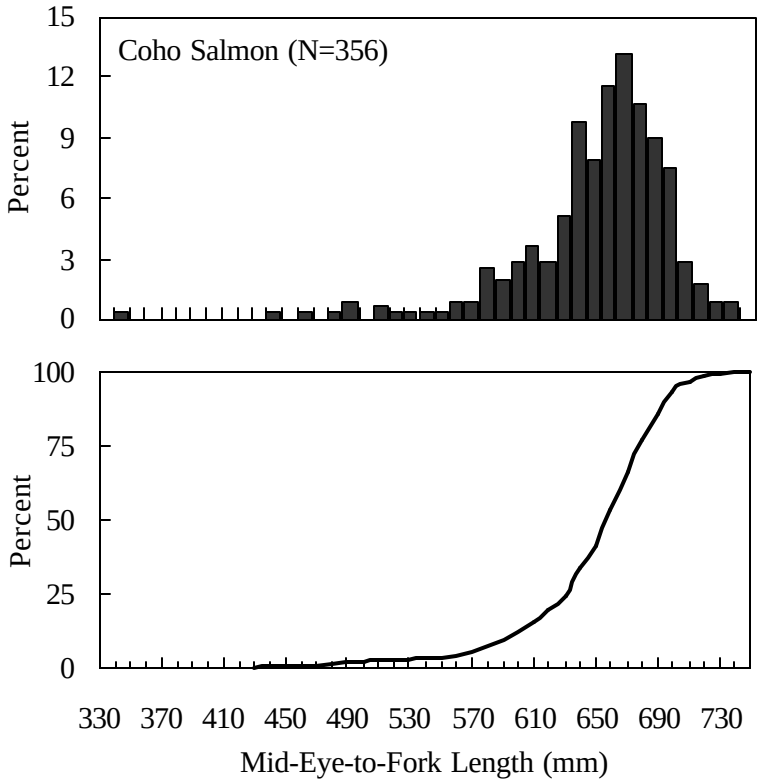


Figure 5. Length (upper) and cumulative length frequency (lower) for coho salmon sampled at the Mortensens Creek weir, 2001.

Table 8. Average, standard error (SE), range, and sample size of lengths taken from coho salmon in Mortensens Creek, 2001

	Ages		
	1.1	2.1	3.1
Females			
Mean Length	632	648	668
SE	5.8	3.5	3.8
Range	582-672	490-704	653-688
Sample Size	14	101	5
Males			
Mean Length	652	657	669
SE	5.3	5.0	5.8
Range	512-735	340-724	558-711
Sample Size	27	142	6
All Fish[a]			
Mean Length	646	652	669
SE	4.5	4.3	3.8
Range	512-735	340-724	558-711
Sample Size	45	260	11

[a] All fish includes fish which were not identified as male or female.

Age 1.3 and 1.2 sockeye salmon were the most abundant in the 2001 Mortensens Creek escapement, similar to what was found in Thin Point Cove and Orzinski River escapements during most years (Bouwens et al. 2001; Nelson et al. 2000; Nelson et al. 1999; Wadle et al. 1999; Nelson et al. 1997; Nelson and Murphy 1996; Nelson and Murphy 1995a; Murphy 1994). However, age composition in those streams was variable from year to year, and at times age classes other than 1.3 and 1.2 were more abundant (2.3, 2.2, and 2.1)(Nelson and Murphy 1995b; Murphy 1992). Thin Point Cove is located about 8 miles southwest of Mortensens Creek while Orzinski River is located further up the Alaska Peninsula near Sand Point.

In Mortensens Creek age 2.1 coho salmon were 82% (SE=2.2%) of the escapement and age 1.1 coho salmon were about 13.6%. The only coho salmon age data available for the Cold Bay area was from the Joshua Green River, located on the west side of the Alaska Peninsula. The predominant age class varied between locations, years, and sexes (Whitton and Eaton, 2001). In 1994, males were predominately age 1.1 and females 2.1. However in 1996, age 2.1 males and females were more abundant. Other studies done on the Alaska Peninsula and western Alaska found that age 2.1 coho salmon were predominant (Price and Larson 1999; West and Gray 2001).

CONCLUSIONS

With only one season of escapement data and limited information on the sport fish harvest, it is not possible to determine whether sockeye and coho salmon populations in Mortensens Creek are sufficient to support, subsistence, commercial, and sport fisheries. Sockeye salmon escapement in 2001 was within the established sustainable escapement goal (SEG) of 3,200 to 6,400 (Nelson and Lloyd 2001). However, escapement is estimated from aerial surveys, whose accuracy is questionable due to dark stream bottoms, turbid water, and inclement weather.

RECOMMENDATIONS

1. Based on the results of the 2001 weir operations, we recommend that the weir be moved slightly upstream of its present location to further reduce tidal influence in an effort to improve the accuracy of the escapement counts. Potential sites were identified prior to weir removal in October.

2. Information on the sport fish harvest is limited therefore, we recommend that a creel survey be conducted to determine effort and harvest levels in the sport and subsistence fisheries. The fishery has a single access point, which would allow the weir crew to interview most fishing parties.

ACKNOWLEDGMENTS

The U.S. Fish and Wildlife Service, Office of Subsistence Management, provided funding support for this project through the Fisheries Resource Monitoring Program, under agreement number FIS01-2006-1. I wish to thank the many people who helped with field work and data entry: Jeremiah Nelson, Alexander Potter, Benjamin Feldman, Robert Gerbi, Kristen Wolen, Jason Bradley, Peter Finch, Jeremy Carlson, Kevin Sims and Michael Harrington. I also thank the staff at the Izembek National Wildlife Refuge for logistical support.

LITERATURE CITED

Alaska Department of Fish and Game. 2000. Alaska Peninsula and Aleutian Islands management areas annual salmon management report, 1999. Division of Commercial Fisheries, Regional Information Report No.4K00-17.

Bouwens, K. A., M. B. Foster, and R. L. Murphy. 2001. Alaska peninsula management area salmon escapement and catch sampling results, 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report No. 4K01-8.

Bromaghin, J. F. 1993. Sample size determination for interval estimation of multinomial probabilities. The American Statistician 47: 203-206.

Cochran, W. G. 1977. Sampling Techniques, 3rd edition. John Wiley & Sons, New York.

Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 1997. Harvest, catch, and participation in Alaska sport fisheries during 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-29 revised.

Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 1998. Harvest, catch, and participation in Alaska sport fisheries during 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-25 revised.

Howe, A.L., R. J. Walker, C. Olnes, G. Heineman, and A. E. Bingham. 1999. Harvest, catch, and participation in Alaska sport fisheries during 1998. Alaska Department of Fish and Game, Fishery Data Series No. 99-41.

Jearld, A. 1983. Age determination. Pages 301-324 *in* L. A. Nielsen and D. L. Johnson, editors. Fisheries Techniques. American Fisheries Society, Bethesda, MD.

Koo, T. S. Y. 1962. Age determination in salmon. Pages 301-324 *in* T. S. Y. Koo, editor. Studies of Alaska red salmon. University of Washington Press, Seattle, Washington.

Murphy, R. L. 1992. Alaska Peninsula and Aleutian Islands management areas commercial salmon catch and escapement statistics, 1990. Alaska Department of Fish and Game, Division of Commercial Fisheries. Technical Fishery Report No. 92-08.

Murphy, R. L. 1994. Alaska Peninsula and Aleutian Islands management areas commercial salmon catch and escapement statistics, 1991. Alaska Department of Fish and Game,

Commercial Fisheries Management and Development Division. Technical Fishery Report No. 94-01.

Nelson, P. A. and D. S. Lloyd. 2001. Escapement goals for Pacific salmon in the Kodiak, Chignik, and Alaska Peninsula/Aleutian Islands areas of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries Regional Information Report No. 4K01-66.

Nelson, P. A. and R. L. Murphy. 1995a. Alaska Peninsula management area salmon escapement and catch sampling results, 1993. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division. Regional Information Report No. 4K95-10.

Nelson, P. A. and R. L. Murphy. 1995b. Alaska Peninsula management area salmon escapement and catch sampling results, 1994. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division. Regional Information Report No. 4K95-34.

Nelson, P. A. and R. L. Murphy. 1996. Alaska Peninsula management area salmon escapement and catch sampling results, 1995. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division. Regional Information Report No. 4K96-36.

Nelson, P. A., R. L. Murphy and C. J. Hicks. 1997. Alaska Peninsula management area salmon escapement and catch sampling results, 1996. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division. Regional Information Report No. 4K97-48.

Nelson, P. A., R. L. Murphy, and J. A. Wadle. 1999. Alaska Peninsula management area salmon escapement and catch sampling results, 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report No. 4K99-42.

Nelson, P. A., M. B. Foster, K. A. Bouwens, and R. L. Murphy. 2000. Alaska Peninsula management area salmon escapement and catch sampling results, 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report No. 4K00-62.

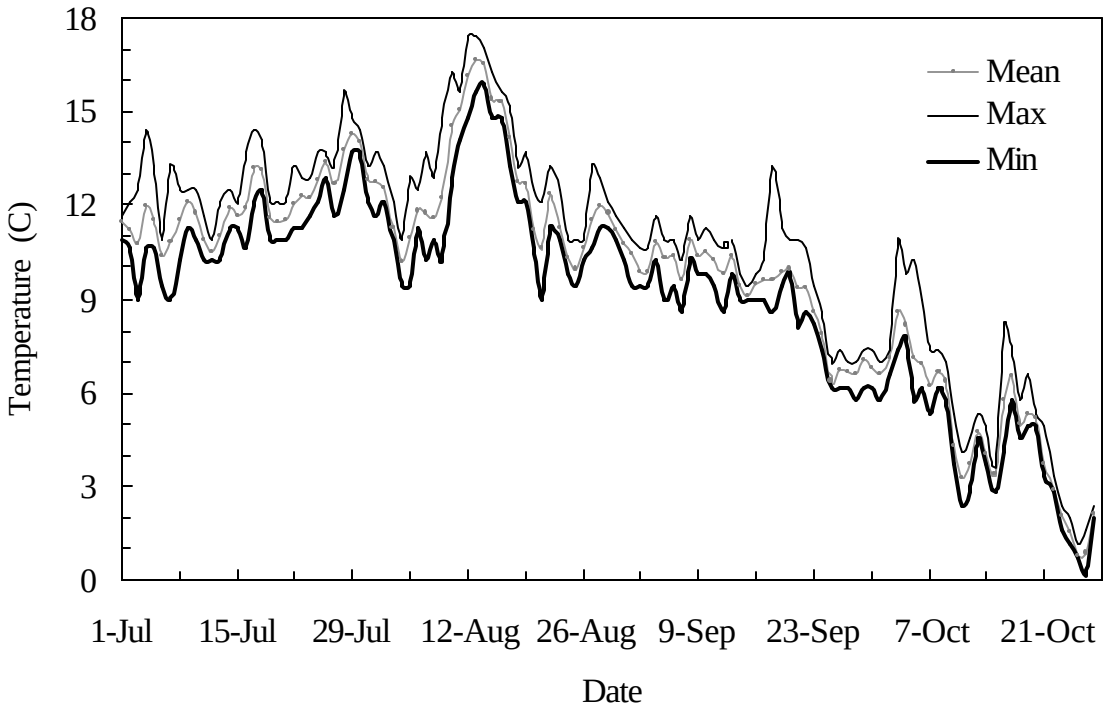
Price, M.A. and J. Larson. 1999. Abundance and run timing of chinook, chum, coho, pink, and sockeye salmon in the Kulukak River, Togiak National Wildlife Refuge, Alaska, 1994-96. U.S. Fish and Wildlife Service, King Salmon, Alaska. Alaska Fisheries Technical Report 52.

Seber, G. A. F. 1982. The estimation of animal abundance and related parameters, 2nd edition. Maxmillan, New York.

Wadle, J. A, P. A, Nelson, and R. L. Murphy. 1999. Alaska Peninsula management area salmon escapement and catch sampling results, 1997. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report No. 4K99-41.

West, F. W. and D. C. Gray. 2001. Abundance, age, sex and size statistics for Pacific salmon in Bristol Bay, 1999-2000. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report No. 2A01-29.

Whitton, K.S. and D. M. Eaton. Joshua Green River Pacific salmon stock assessment and resident fish species survey, Izembek National Wildlife Refuge, Alaska 1994-1996. U.S. Fish and Wildlife Service, King Salmon Fishery Resource Office, King Salmon, Alaska. Alaska Fisheries Data Series Number 2001-3.



Appendix 1. Mean, maximum, and minimum water temperatures in Mortensens Creek, Alaska, 2001.

Appendix 2. Daily counts, cumulative counts (Cum.), and cumulative percent (Cum. %) of sockeye, coho, pink, and chum salmon escapement through the Mortensens Creek weir, 2001.

	Sockeye Salmon			Coho Salmon			Pink	Chum Salmon
Date	Daily	Cum.	Cum. %	Daily	Cum.	Cum. %	Daily	Daily
Jul 1	11	11	0.26	0	0	0.00	0	0
Jul 2[a]	6	17	0.40	0	0	0.00	0	0
Jul 3	0	17	0.40	0	0	0.00	0	0
Jul 4	0	17	0.40	0	0	0.00	0	0
Jul 5	0	17	0.40	0	0	0.00	0	0
Jul 6	0	17	0.40	0	0	0.00	0	0
Jul 7	0	17	0.40	0	0	0.00	0	0
Jul 8	2	19	0.45	0	0	0.00	0	0
Jul 9	0	19	0.45	0	0	0.00	0	0
Jul 10	0	19	0.45	0	0	0.00	0	0
Jul 11	0	19	0.45	0	0	0.00	0	0
Jul 12	0	19	0.45	0	0	0.00	0	0
Jul 13	1	20	0.47	0	0	0.00	0	0
Jul 14[a]	64	84	1.97	0	0	0.00	0	0
Jul 15	535	619	14.50	0	0	0.00	0	0
Jul 16	27	646	15.14	0	0	0.00	0	0
Jul 17	20	666	15.60	0	0	0.00	0	0
Jul 18	17	683	16.00	0	0	0.00	0	0
Jul 19	37	720	16.87	0	0	0.00	0	0
Jul 20	4	724	16.96	0	0	0.00	0	0
Jul 21	1	725	16.99	0	0	0.00	0	0
Jul 22	31	756	17.71	0	0	0.00	0	0
Jul 23	51	807	18.91	0	0	0.00	0	0
Jul 24	69	876	20.52	0	0	0.00	0	0
Jul 25	13	889	20.83	0	0	0.00	0	0
Jul 26	1	890	20.85	0	0	0.00	0	0
Jul 27	42	932	21.84	0	0	0.00	0	0
Jul 28	4	936	21.93	0	0	0.00	0	0
Jul 29	104	1,040	24.37	0	0	0.00	0	0
Jul 30	3	1,043	24.44	0	0	0.00	0	0
Jul 31	148	1,191	27.91	0	0	0.00	0	0
Aug 1	1	1,192	27.93	0	0	0.00	0	0
Aug 2	331	1,523	35.68	0	0	0.00	0	0

Appendix 1.&Continued

	Sockeye Salmon			Coho Salmon			Pink	Chum Salmon
Date	Daily	Cum.	Cum. %	Daily	Cum.	Cum. %	Daily	Daily
Aug 3	3	1,526	35.75	0	0	0.00	0	0
Aug 4	0	1,526	35.75	0	0	0.00	0	0
Aug 5	1	1,527	35.78	0	0	0.00	0	0
Aug 6	3	1,530	35.85	0	0	0.00	0	0
Aug 7	13	1,543	36.15	0	0	0.00	0	0
Aug 8	2,057	3,600	84.35	0	0	0.00	0	0
Aug 9	92	3,692	86.50	0	0	0.00	0	0
Aug 10	10	3,702	86.74	0	0	0.00	0	0
Aug 11	8	3,710	86.93	0	0	0.00	0	0
Aug 12	74	3,784	88.66	0	0	0.00	0	0
Aug 13	19	3,803	89.10	0	0	0.00	0	0
Aug 14	2	3,805	89.15	0	0	0.00	0	0
Aug 15	84	3,889	91.12	0	0	0.00	0	0
Aug 16	56	3,945	92.43	0	0	0.00	0	0
Aug 17	10	3,955	92.67	0	0	0.00	0	0
Aug 18	2	3,957	92.71	0	0	0.00	0	0
Aug 19	108	4,065	95.24	0	0	0.00	0	0
Aug 20	18	4,083	95.67	0	0	0.00	1	0
Aug 21	1	4,084	95.69	1	1	0.02	0	1
Aug 22	7	4,091	95.85	2	3	0.06	2	0
Aug 23	3	4,094	95.92	0	3	0.06	1	1
Aug 24	0	4,094	95.92	0	3	0.06	0	2
Aug 25	0	4,094	95.92	0	3	0.06	0	0
Aug 26	21	4,115	96.42	0	3	0.06	1	2
Aug 27	5	4,120	96.53	0	3	0.06	1	0
Aug 28	4	4,124	96.62	0	3	0.06	1	3
Aug 29	1	4,125	96.95	5	8	0.15	0	0
Aug 30	0	4,125	96.65	0	8	0.15	0	0
Aug 31	0	4,125	96.65	0	8	0.15	0	0
Sep 1	60	4,185	98.06	3	11	0.21	0	2
Sep 2	3	4,188	98.13	8	19	0.36	1	3
Sep 3	10	4,198	98.36	14	33	0.63	2	2
Sep 4	16	4,214	98.73	11	44	0.83	1	1

Appendix 1.&Continued

	Sockeye Salmon			Coho Salmon			Pink	Chum Salmon
Date	Daily	Cum.	Cum %	Daily	Cum.	Cum. %	Daily	Daily
Sep 5	22	4,236	99.25	6	50	0.95	2	0
Sep 6	4	4,240	99.34	7	57	1.08	1	1
Sep 7	8	4,248	99.53	8	65	1.23	0	0
Sep 8	14	4,262	99.86	14	79	1.50	0	0
Sep 9	2	4,264	99.91	0	79	1.50	0	2
Sep 10	4	4,268	100.00	180	259	4.91	1	0
Sep 11[a]	0	4,268	100.00	1,535	1,794	33.98	0	1
Sep 12	0	4,268	100.00	343	2,137	40.48	0	0
Sep 13	0	4,268	100.00	55	2,192	41.52	0	0
Sep 14	0	4,268	100.00	29	2,221	42.07	0	0
Sep 15	0	4,268	100.00	565	2,786	52.78	0	0
Sep 16	0	4,268	100.00	211	2,997	56.77	0	0
Sep 17	0	4,268	100.00	173	3,170	60.05	0	0
Sep 18	0	4,268	100.00	236	3,406	64.52	0	0
Sep 19[b]	0	4,268	100.00	317	3,723	70.52	0	0
Sep 20	0	4,268	100.00	685	4,408	83.50	0	0
Sep 21	0	4,268	100.00	313	4,721	89.43	0	0
Sep 22	0	4,268	100.00	17	4,738	89.75	0	0
Sep 23	0	4,268	100.00	24	4,762	90.21	0	0
Sep 24	0	4,268	100.00	13	4,775	90.45	0	0
Sep 25	0	4,268	100.00	4	4,779	90.53	0	0
Sep 26	0	4,268	100.00	18	4,797	90.87	0	0
Sep 27	0	4,268	100.00	16	4,813	91.17	0	0
Sep 28	0	4,268	100.00	2	4,815	91.21	0	0
Sep 29	0	4,268	100.00	0	4,815	91.21	0	0
Sep 30	0	4,268	100.00	5	4,820	91.31	0	0
Oct 1	0	4,268	100.00	4	4,824	91.38	0	0
Oct 2	0	4,268	100.00	0	4,824	91.38	0	0
Oct 3	0	4,268	100.00	0	4,824	91.38	0	0
Oct 4	0	4,268	100.00	5	4,829	91.48	0	0
Oct 5	0	4,268	100.00	35	4,864	92.14	0	0
Oct 6	0	4,268	100.00	80	4,944	93.65	0	0
Oct 7[a]	0	4,268	100.00	26	4,970	94.15	0	0

Appendix 1.&Continued

	Sockeye Salmon			Coho Salmon			Pink	Chum Salmon
Date	Daily	Cum.	Cum. %	Daily	Cum.	Cum. %	Daily	Daily
Oct 8	0	4,268	100.00	50	5,020	95.09	0	0
Oct 9	0	4,268	100.00	36	5,056	95.78	0	0
Oct 10	0	4,268	100.00	11	5,067	95.98	0	0
Oct 11	0	4,268	100.00	11	5,078	96.19	0	0
Oct 12	0	4,268	100.00	2	5,080	96.23	0	0
Oct 13	0	4,268	100.00	0	5,080	96.23	0	0
Oct 14	0	4,268	100.00	3	5,083	96.28	0	0
Oct 15	0	4,268	100.00	1	5,084	96.31	0	0
Oct 16[a]	0	4,268	100.00	37	5,121	97.01	0	0
Oct 17	0	4,268	100.00	115	5,236	99.19	0	0
Oct 18	0	4,268	100.00	36	5,272	99.87	0	0
Oct 19	0	4,268	100.00	5	5,277	99.96	0	0
Oct 20	0	4,268	100.00	2	5,279	100.00	0	0
Oct 21	0	4,268	100.00	0	5,279	100.00	0	0
Oct 22	0	4,268	100.00	0	5,279	100.00	0	0
Oct 23	0	4,268	100.00	0	5,279	100.00	0	0
Oct 24	0	4,268	100.00	0	5,279	100.00	0	0
Oct 25	0	4,268	100.00	0	5,279	100.00	0	0
Oct 26	0	4,268	100.00	0	5,279	100.00	0	0
Total	4,268	4,268	100.00	5,279	5,279	100.00	15	21

[a] May be a partial count due to high tide-wind event.

[b] Partial count because weir went down during the night.